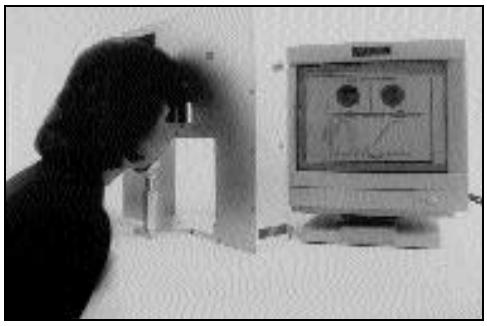
AMT: BINOCULAR 3-D EYE TRACKER



A novel wavefront sensor can help doctors remotely diagnose eye disorders.

While our view of the world may seem smooth and uninterrupted to us, the continual, jerky movements of the eye are essential to maintaining this clear image. Paradoxically, if these eye movements are artificially stilled, the world becomes a defocused blur.

BMDO HISTORY

Applied Modern Technologies Corporation (AMT; Huntington Beach, CA) has developed an eye-tracking device based on wavefront sensor technology borrowed from adaptive optics. In the 1980s, BMDO focused much attention on how light, particularly high-energy laser light, was propagated through the atmosphere. This interest generated a host of techniques to correct the scatter of light in turbulent air, improving both transmission and detection of light. The astronomy field has benefited greatly from advances in adaptive optics—for example, using it to remove the "twinkle" from galactic objects—but other areas of science are also reaping the rewards of this technology. AMT's Ocular Vergence and Accommodation Sensor (OVAS) is a new product for the vision sciences and medical research that can trace its lineage to BMDO adaptive optics technology.

HOW IT WORKS

OVAS uses two low-power (1.25 milliwatts per square centimeter; eye-safe) infrared laser beams that are reflected from each eye's retina. The reflection provides information about the movement of the eyes and other biometric data that can be processed and used for a variety of applications. AMT's design includes a 12-component optics system and a Pentium processor with algorithms for processing data on the accommodative state, movements, and vergence of the eyes, as well as 10 other ocular functions.

MEDICAL SIGNIFICANCE

Telemedicine. OVAS could provide diagnostic data from a patient to a doctor many miles away. The application to soldiers in the field includes early detection of exposure to chemical warfare agents. The AMT system is rugged enough for battlefield conditions and can be miniaturized for integration into a portable, head-mounted system. OVAS is proposed as part of a testbed project for remote ophthalmic instruments for the Tripler Army Medical Center. The center's responsibilities include health care for the U.S. South Pacific Protectorate. Doctors are scarce on these small islands, and often the citizenry and military personnel must make do with limited immediate medical care. With OVAS, an ophthalmologist at a remote location may be able to evaluate a Tripler patient's eyes for corrective eyewear and for such conditions as cataracts and diabetic retinopathy.

The South Pacific population experiences a very high rate of diabetes-related blindness.

Ophthalmology and Optometry. OVAS is an automated system that can determine prescription lens strength, astigmatism, interpupil distance, and accommodation. Because OVAS is binocular, both eyes are measured simultaneously. AMT feels this is superior to the current practice, which measures each eye separately. Potentially, lens prescriptions could be balanced to reduce the dominant-eye effect now common for corrected vision. Future units can be used to precisely measure the minute aberrations of the cornea, helping to fit contact lenses or to determine the depth of abrasions. In surgery, OVAS could identify astigmatism introduced by the surgery and allow immediate correction. The benefits extend to school children for a quick, accurate eye-screening device and to faster, more in-depth eye exams requiring no feedback from the patient.

Other Medical Applications

For those who are paralyzed or seriously restricted in their ability to move, eye movement sensors have been in use for some time. With an "ocular mouse," the user can look at an icon or array of letters on a monitor to initiate a program function or spell out words. These assistive computer interfaces add immensely to the quality of life of such individuals, and sensors that can accurately track eye movement are crucial to the technology.

Medical students, residents, and interns are taking increasing advantage of virtual reality (VR) for educational purposes. Surgical trainees can now practice such procedures as laparoscopies on a VR simulator before moving on to real patients. VR also needs eye movement and focusing information for its next-generation products.

VENTURES OR PRODUCT AVAILABILITY

AMT has applied for 89 patents related to OVAS and is marketing a research version of OVAS aimed at the medical market. This includes studies where OVAS' data points are used for statistical analysis and include vision research, neuro-ophthalmology, display research, VR research, and scene generation. OVAS is suitable for office, laboratory, or mobile use.

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